

Lab 12: Predator/Prey Evolution

Whenever reproduction favors some members of a population over others, the genetic structure of that population is different in each succeeding generation. In a small population, random events can lead to genetic drift. When population size is larger, random events have a smaller impact on the population as a whole, and other types of genetic change are possible. Forces that favor the reproduction of individuals with a certain phenotype are called selection, and tend to drive genetic change in a particular direction.

Objectives

When you have successfully completed this lab, you should be able to:

1. Explain directional selection and genetic drift.
2. Understand how violation of the criteria for Hardy-Weinberg equilibrium leads to change over time.
3. Find real-world examples of genetic change in populations.

Introduction

Unlike Mendel, we do not have the time to raise several generations of plants or animals in the lab. Instead, we will simulate the reproduction of two species - one predator and one prey. Predators will be played by Biology 107 students. The prey species will be represented by beans. Species are present in several phenotypes (morphs). Predators will vary by feeding tool: knife, fork, spoon, forceps or fingers, while prey vary by type of bean: lima, navy, pinto, lentil, black-eye. We will not simulate all of the complexities of genetics, but, in general, phenotypes that confer a survival advantage will tend to be more prevalent in succeeding generations.

Each generation, predators will hunt for prey. Those who capture enough prey will reproduce. In each lab section, the number of students who carry

the alleles for any particular morph will be small, so random events can quickly change the allele frequencies in the population. For example, if there are only two finger-morph predators, these alleles could be totally lost if one predator accidentally spills her prey while the other is “killed” by a knife-morph predator. This type of change is called genetic drift, and only occurs in small populations. The prey, on the other hand, have a large population size. It wouldn't really matter if one or two extra lentils in a population of five hundred were captured in a feeding round.

Genetic change in the prey population will be driven by other factors. The beans will be hidden on one of two environments: fall or winter (wooden boxes filled with dry leaves (fall) or packing pellets (winter)). The color and size of the different prey morphs will make them easier or harder to find, and they will be captured in different numbers. At the end of each round, the beans will reproduce, bringing their total number back to 500. We will start with 100 of each type of bean, but this will change as some beans are captured more often (and therefore reproduce less). This simulation usually shows directional selection based on color and size in the prey populations.

Before beginning the laboratory exercise, type a one-page summary of what you think will happen to the various predator and prey morphs in each of the environments during the simulation. Which morphs will increase and/or decrease in numbers over time? What effect might environmental differences have on evolution? Why do you think this will happen?

This summary will serve as your hypothesis, which you can later evaluate in light of your experimental results. Hand in your hypothesis summary before the beginning of the laboratory period.

Procedures

Your instructor will explain the simulation to you at the beginning of the lab period. Use the data sheet on the following page to keep track of your capture data. After each round your data will be entered into the lab computer and posted on the class web site. Don't worry about keeping track of all of the numbers for the whole class. Do be careful with your own counting and prey identification. Mistakes in number or type of beans taken can result in unusable data.

Lab Assignment - Exercise 8

This assignment is to be handed in before 5:00 PM on reading day (December 7). Each student must complete this assignment individually.

- A. Write an essay (typed; 3 pages maximum, including graphs) that uses properly graphed data from this lab to evaluate your hypothesis in light of your results. Make sure you also use your data to define, explain and illustrate both directional selection and genetic drift. This assignment does not need to follow the format of a lab report, but figures should still be properly constructed and referred to.
 - B. Find a short report from the current scientific or popular literature that gives a real-world example of directional selection or genetic drift. Write a short essay (typed, 1-2 pages) explaining how your article is relevant to topics from this lab exercise. Turn in the article and your essay.
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NAME:

LAB SECTION:

CARD:

ROUND #:

1

2

3

4

5

6

7

MORPH/ENV
(e.g. Fall Spoon)

NAVY

LIMA

PINTO


LENTIL

BL. EYE

MY # KILLED

CLASS AVG. KILL

MY OUTCOME

For each prey type in each round,
fill in your number here,  and your morph total here.